# Putting It All Together: Software Planning, Estimation and Risk Assessment for a Successful Project

Tim Kurtz
SAIC
NASA Glenn Research Center
Cleveland, OH, USA

Martin Feather
NASA Jet Propulsion Lab
Pasadena, CA, USA

http://tkurtz.grc.nasa.gov/pete

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# Approach to Putting "it" Together

Three phased approach

1. Characterize the project
   - COCOMO II
   - ISO 9001 Development Processes
   - IV&V Criteria
2. Tune the Risk Strategy
3. Planning and Implementation

Tim Kurtz
SAIC/NASA Glenn Research Center
Cleveland, OH, USA

Martin Feather
NASA Jet Propulsion Lab
Pasadena, CA, USA

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# Phase 1: Characterize the Project

## Use Common and Specific Tools

- COCOMO Cost Estimation
- Software Control Level Matrix (tailored version of DERA Size matrix)
- NASA Independent Verification and Validation Criteria

Tim Kurtz
SAIC/NASA Glenn Research Center
Cleveland, OH, USA

Martin Feather
NASA Jet Propulsion Lab
Pasadena, CA, USA

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# Phase 1: Characterize the Project
## Development Framework - COCOMO II

Factors derived from COCOMO II

- Cost of development
- Schedule
- Personnel requirements
- Size of project
- Software Reuse

Tim Kurtz
SAIC/NASA Glenn Research Center
Cleveland, OH, USA

Martin Feather
NASA Jet Propulsion Lab
Pasadena, CA, USA

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# Phase 1: Characterize the Project
## Development Framework - Control Level

Characterization Factors from Control Level

- Organizational Complexity
  - Customers (internal – multiple industries)
  - Development site(s) (single – multiple sites)
- Technical Complexity
  - Degree of Innovation
  - Use of tools
  - Interdependencies of Deliverables
- Consequence of Failure
  - Safety Implications
  - Business Implications

Tim Kurtz
SAIC/NASA Glenn Research Center
Cleveland, OH, USA

Martin Feather
NASA Jet Propulsion Lab
Pasadena, CA, USA

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# Phase 1: Characterize the Project

## Determine Need for IV&V or Independent Assessment

Factors From Independent Verification & Validation

- The need for IV&V is based on possible effect and extent of failure of the software to perform as intended.

Factors Used to Calculate:

- Resources (manpower) expended
- Investment (money) expended
- Effect of failure on personnel and equipment

Tim Kurtz
SAIC/NASA Glenn Research Center
Cleveland, OH, USA

Martin Feather
NASA Jet Propulsion Lab
Pasadena, CA, USA

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# Phase 1: Characterize the Project

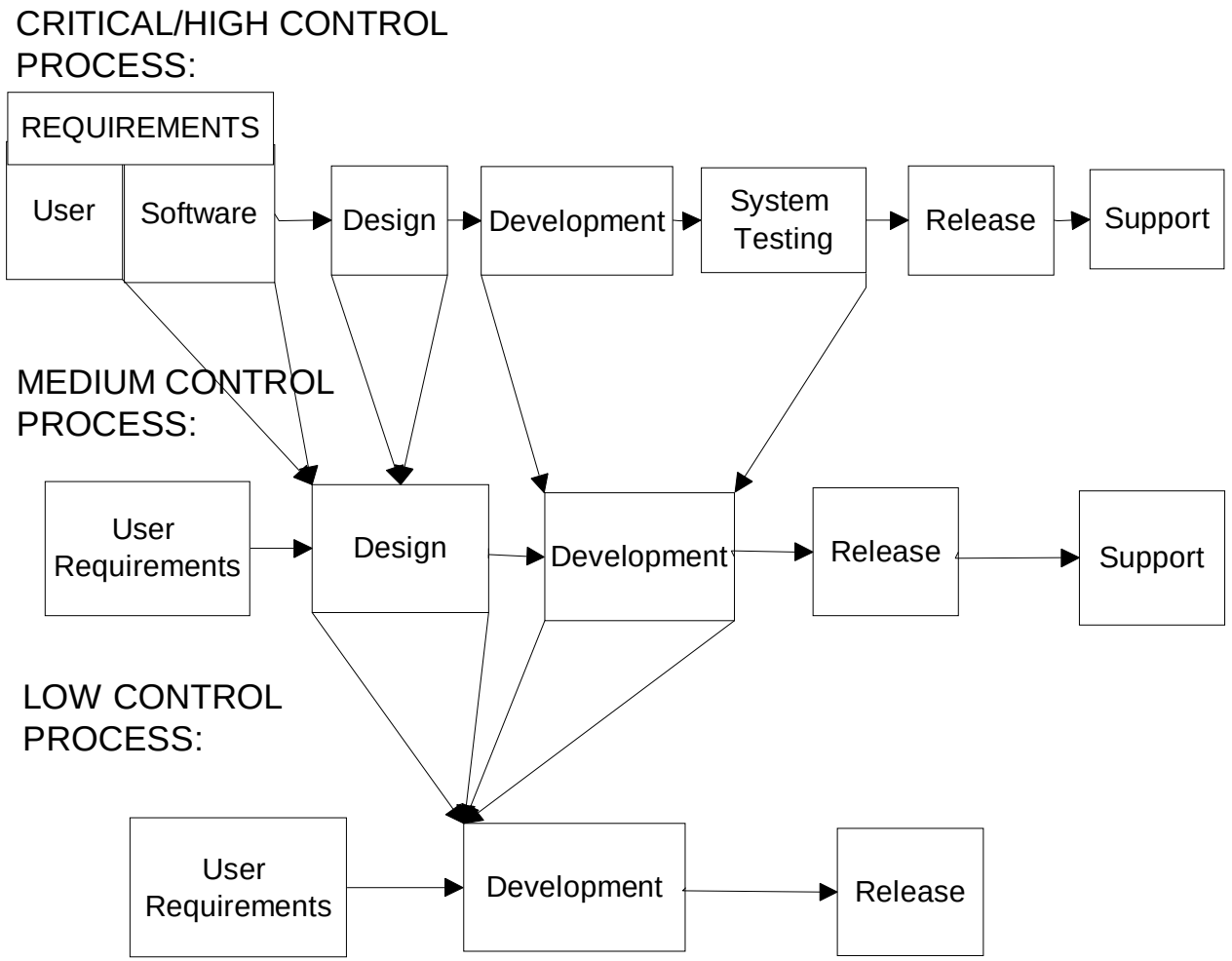
## Tailor Development Processes

**Software Control Levels**

**Critical/High Control Level**

**Medium Control Level**

**Low Control Level**





Tim Kurtz
SAIC/NASA Glenn Research Center
Cleveland, OH, USA

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Pasadena, CA, USA



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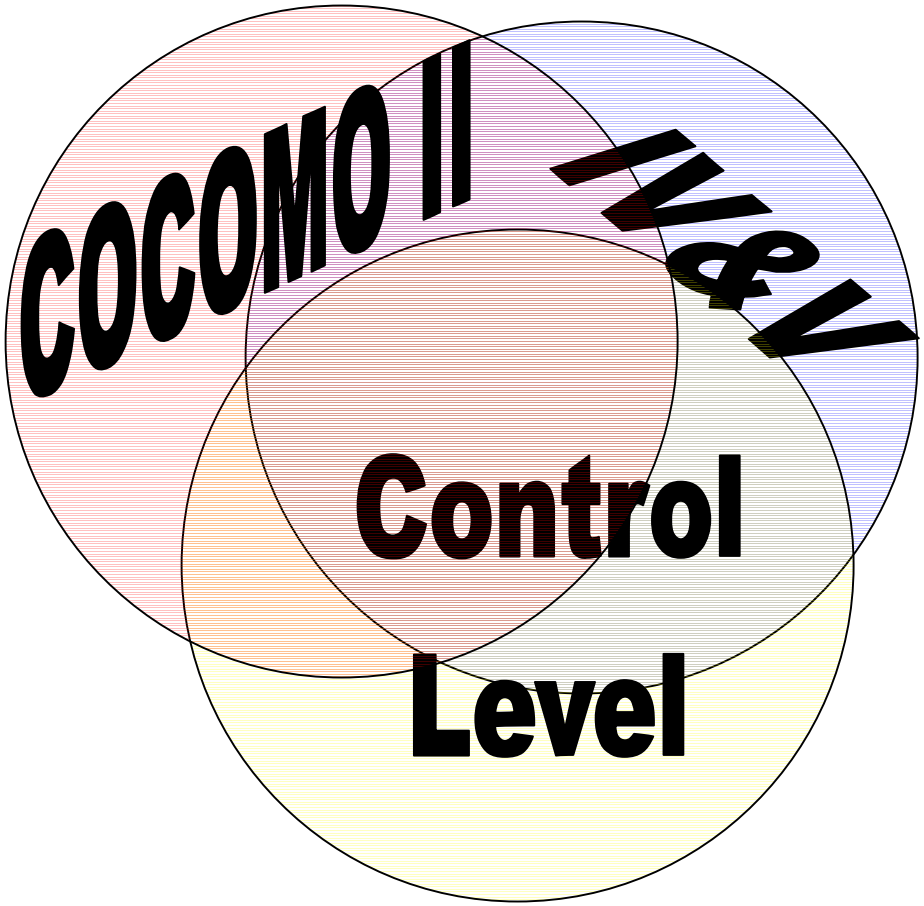
# Phase 1: Characterize the Project

## Build on Common Areas




- COCOMO II factors address majority of the development planning issues
- Control Level factors overlap COCOMO II and address additional organizational and performance issues
- Incorporating other areas of interest, (i.e. IV&V, Software Assurance), build on COCOMO II and Control level questions

Tim Kurtz
SAIC/NASA Glenn Research Center
Cleveland, OH, USA

Martin Feather
NASA Jet Propulsion Lab
Pasadena, CA, USA

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# Phase 1: Characterize the Project

## Outcomes

- What the project will cost (personnel, money)
- How long the project will take
- What controls are required, What documents need to be generated
- What activities need to be performed
- An initial set of risk mitigations based on the project's parameters

Tim Kurtz
SAIC/NASA Glenn Research Center
Cleveland, OH, USA

Martin Feather
NASA Jet Propulsion Lab
Pasadena, CA, USA

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# Phase 1: Characterize the Project

## Identify Initial Mitigation Set Based on Control Level

| Pact Id | Pact Title | Percent Time | Percent Cost | Absolute Cost | Absolute Time | Low Pact | Medium Pact | High Pact | Critical Pact |
|---|---|---|---|---|---|---|---|---|---|
| P9 | Requirements | 0 | 0 | $0.00 | 0 | X | X | X | X |
| P10 | Authorization to proceed | 0 | 0 | $0.00 | 0 | X | X | X | X |
| P11 | Identify design/coding standards | 0 | 0 | $0.00 | 0 | X | X | X | X |
| P12 | Maintain Software Development Folder | 0 | 0 | $0.00 | 0 | | X | X | X |
| P13 | Software Assurance reviews Management Plan | 0 | 0 | $0.00 | 0 | | X | X | X |
| P14 | Implement Problem report and corrective action system | 0 | 0 | $0.00 | 0 | | X | X | X |
| P15 | Management Plan approval | 0 | 0 | $0.00 | 0 | X | X | X | X |
| P16 | Documented requirements | 0 | 0 | $0.00 | 0 | X | X | X | X |
| P17 | Peer review of requirements | 0 | 0 | $0.00 | 0 | | X | X | X |
| P18 | Conduct formal inspection of requirements | 0 | 0 | $0.00 | 0 | | | | X |
| P19 | Software Assurance reviews requirements | 0 | 0 | $0.00 | 0 | | | X | X |
| P20 | Requirements approval | 0 | 0 | $0.00 | 0 | X | X | X | X |
| P21 | Peer review of plans | 0 | 0 | $0.00 | 0 | | | X | X |
| P22 | Implement Formal configuration management | 0 | 0 | $0.00 | 0 | | | X | X |
| P23 | Conduct Product Assurance Audits | 0 | 0 | $0.00 | 0 | | | X | X |
| P24 | Conduct Formal Reviews | 0 | 0 | $0.00 | 0 | | | X | X |
| P25 | Document approval of requirements and formal review | 0 | 0 | $0.00 | 0 | | | X | X |
| P26 | Customer approval of certification procedures | 0 | 0 | $0.00 | 0 | | | | X |
| P27 | Conduct analyses of criticality and safety | 0 | 0 | $0.00 | 0 | | | | X |
| P28 | Plan and schedule IV&V activities | 0 | 0 | $0.00 | 0 | | | | X |
| P29 | Identify method for verification of safety critical functions and requirements | 0 | 0 | $0.00 | 0 | | | | X |

Tim Kurtz
SAIC/NASA Glenn Research Center
Cleveland, OH, USA

Martin Feather
NASA Jet Propulsion Lab
Pasadena, CA, USA

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# Phase 2: Tune Risk Strategy Terminology

- Risks - combination of likelihood (probability of occurrence) and impact (how much damage it will do if it occurs).
- PACT - risk mitigation, implementation of a PACT will have some effectiveness in reducing one or more risks
  - **P**reventive measures
  - **A**nalyses
  - process **C**ontrols
  - **T**ests

Tim Kurtz
SAIC/NASA Glenn Research Center
Cleveland, OH, USA

Martin Feather
NASA Jet Propulsion Lab
Pasadena, CA, USA

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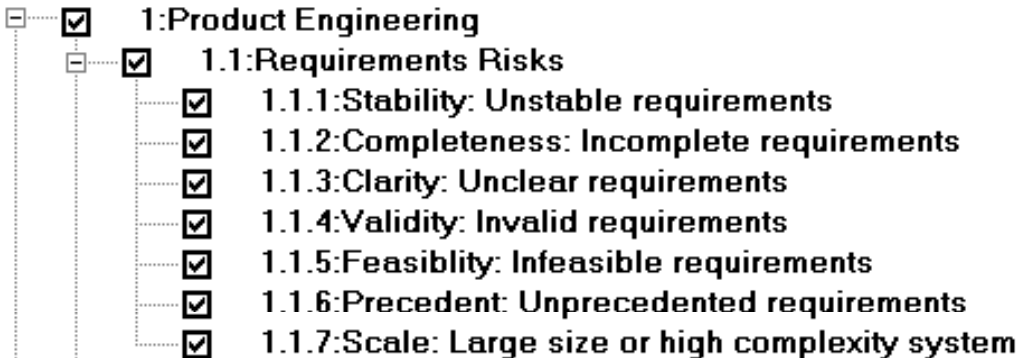
# Phase 2: Tune Risk Strategy
## Identify and Prioritize Specific Risks

- Identify project specific risks
  - Start with the Software Engineering Institute's Software Risk Taxonomy as the base set of software development risks
  - Remove inapplicable risks and add project specific risks




Prioritize risks based on requirements

Tim Kurtz
SAIC/NASA Glenn Research Center
Cleveland, OH, USA

Martin Feather
NASA Jet Propulsion Lab
Pasadena, CA, USA

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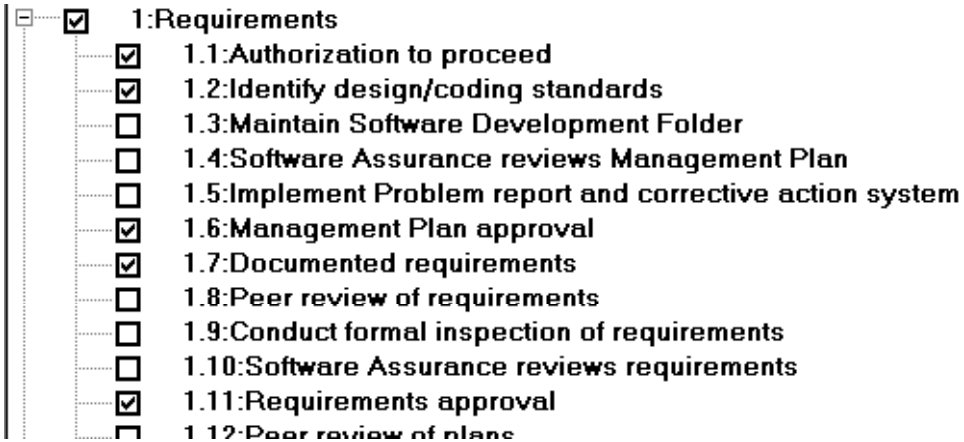
# Phase 2: Tune Risk Strategy

## Identify Risk Mitigations




- An initial set of mitigations was identified based on the characteristics of the project
- Adjust the mitigations based on available resources and impact to the risks

Tim Kurtz
SAIC/NASA Glenn Research Center
Cleveland, OH, USA

Martin Feather
NASA Jet Propulsion Lab
Pasadena, CA, USA

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# Phase 2: Tune Risk Strategy

## Estimate Risk Mitigation Effectiveness

**PACTxFM** Col = Stability: Unstable requirements; Row = Authorization to proceed

| | | FMs | [-]Product Engineering | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | FMs | [-]Requirements Risks | | | | | | | [-]Design Ri | |
| | | FMs | Stabilit | Compl | Clarity: | Validity | Feasib | Precec | Scale: | Functic | Diffi |
| PACTs | PACTs | FoM\R | 0.2835 | 0.0405 | 0.0405 | 0.3645 | 0.2835 | 0.2205 | 0.2657 | 0.0255 | 0.02 |
| [-]Requ | Authori | 7.95 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.3 | 0.1 | | |
| | Identify | 2.5 | | | | | | | | 0.3 | 0.3 |
| | Mainta | 0 | | | | | | | | | |
| | Softwa | 2.65 | | | | | | | | | |
| | Implem | 1.85 | 0.9 | 0.3 | 0.9 | 0.9 | 0.3 | 0.3 | 0.1 | | |
| | Manag | 0.15 | | | | | | | | | |
| | Docum | 1.7 | 0.3 | 0.9 | 0.9 | 0.1 | 0.3 | 0.3 | 0.1 | 0.1 | |
| | Peer | 2.85 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.1 | 0.1 | |
| | Conduc | 2.85 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.1 | 0.1 | |
| | Softwa | 2.8 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.1 | 0.1 | |
| | Requir | 0 | | | | | | | | | |

- Each mitigation only affects a subset of risks
- Each risk is affected to a different degree
- The effect of a mitigation on a risk may need to be adjusted from one project to another

Tim Kurtz
SAIC/NASA Glenn Research Center
Cleveland, OH, USA

Martin Feather
NASA Jet Propulsion Lab
Pasadena, CA, USA

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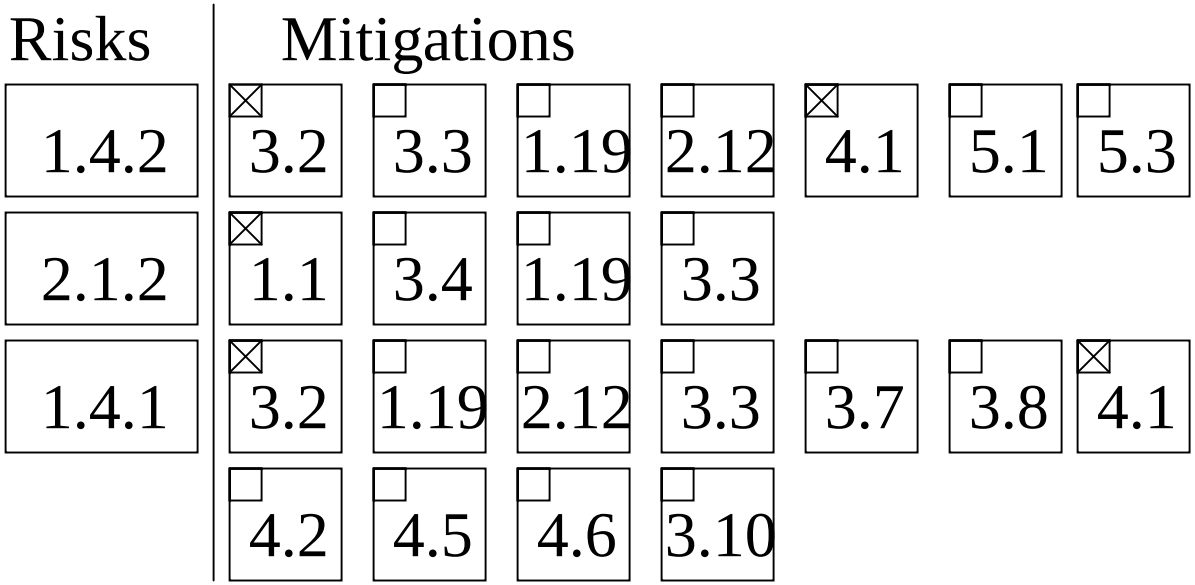
# Phase 2: Tune Risk Strategy

## Tune Mitigations to Maximize Resources




- Select mitigations
  - Which have a greater impact on a single risk
  - Affect a range of risks

Tim Kurtz
SAIC/NASA Glenn Research Center
Cleveland, OH, USA

Martin Feather
NASA Jet Propulsion Lab
Pasadena, CA, USA

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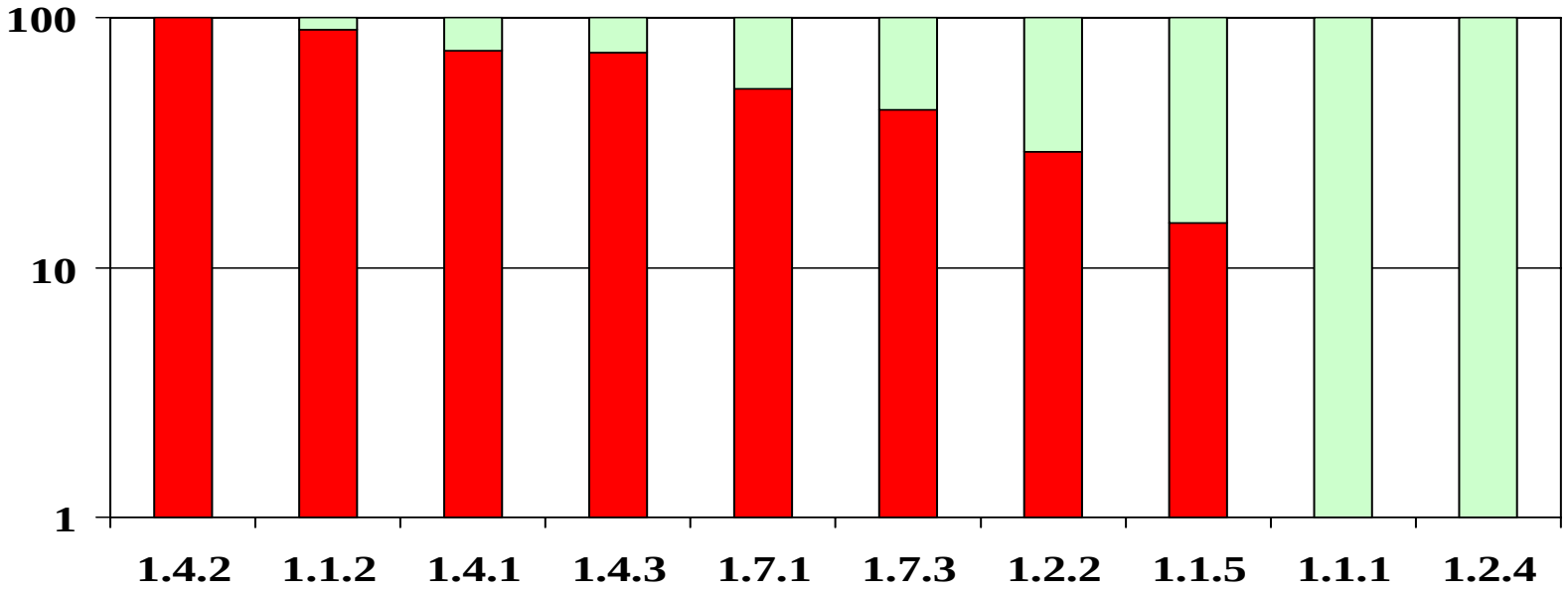
# Phase 2: Tune Risk Strategy

## Tune Mitigations to Maximize Resources




Pareto risks to determine which have yet to be mitigated to an acceptable level

Tim Kurtz
SAIC/NASA Glenn Research Center
Cleveland, OH, USA

Martin Feather
NASA Jet Propulsion Lab
Pasadena, CA, USA

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# Phase 2: Tune Risk Strategy

## Outcomes

A tailored set of risk mitigations for the project which includes

- A set of risks applicable to the project
- A set of risk mitigations applicable to the project risks
- The costs of the risks and mitigations in time and effort

Tim Kurtz
SAIC/NASA Glenn Research Center
Cleveland, OH, USA

Martin Feather
NASA Jet Propulsion Lab
Pasadena, CA, USA

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# Phase 3: Planning and Implementation
## Combine and Implement Mitigations

- Original estimates are supplemented based on selected mitigation strategies
- Resulting impact on the project can be reviewed and adjusted
  - Budget
  - Schedule
  - SPA activities

Tim Kurtz
SAIC/NASA Glenn Research Center
Cleveland, OH, USA

Martin Feather
NASA Jet Propulsion Lab
Pasadena, CA, USA



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# Phase 3: Planning and Implementation
## Develop Plans

- Project Development and Product Assurance plans are developed based on
  - Characteristics of the project
  - Risks
  - Risk mitigations
  - Organizations development activities
  - ISO 9001
  - COCOMO II estimates

Tim Kurtz
SAIC/NASA Glenn Research Center
Cleveland, OH, USA

Martin Feather
NASA Jet Propulsion Lab
Pasadena, CA, USA

Research funded by NASA OSMA and GSFC IV&V Facility

# Phase 3: Planning and Implementation Development Plan

- Start with a development plan for a Critical Control project
- Tailor the plan to the appropriate level by removing activities and deliverables that don't provide the needed cost/benefit ratio for the effort.
- Address each development phase and associated documentation

Tim Kurtz
SAIC/NASA Glenn Research Center
Cleveland, OH, USA

Martin Feather
NASA Jet Propulsion Lab
Pasadena, CA, USA



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# Phase 3: Planning and Implementation Other Project Tasks

## Software Product Assurance Plan

- Lists needed Software Product Assurance activities for the level of control
- Provides Software Product Assurance effort estimates based on the results

## Level of IV&V

- Identifies if Independent Assessment or IV&V necessary for the project
- Suggests activities and processes
- If IV&V is indicated: level and tasks should be negotiated and documented in Software Management Plan

Tim Kurtz
SAIC/NASA Glenn Research Center
Cleveland, OH, USA

Martin Feather
NASA Jet Propulsion Lab
Pasadena, CA, USA

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# Phase 3: Planning and Implementation Outcomes

- Development Plan based on:
  - control level
  - documentation requirements
  - risk
- Product Assurance Plan based on:
  - development activities
- Risk mitigation activities based on:
  - control level
  - risks
  - resources

Tim Kurtz
SAIC/NASA Glenn Research Center
Cleveland, OH, USA

Martin Feather
NASA Jet Propulsion Lab
Pasadena, CA, USA

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# Summary for Putting It All Together

- Provided approach for managing software development
- Described a process
  - Coordination between factors
  - Tailoring to specific project needs
- Presented a Framework, incorporating
  - Estimation
  - Corporate Processes and Resources
  - Risk Management
  - Planning

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